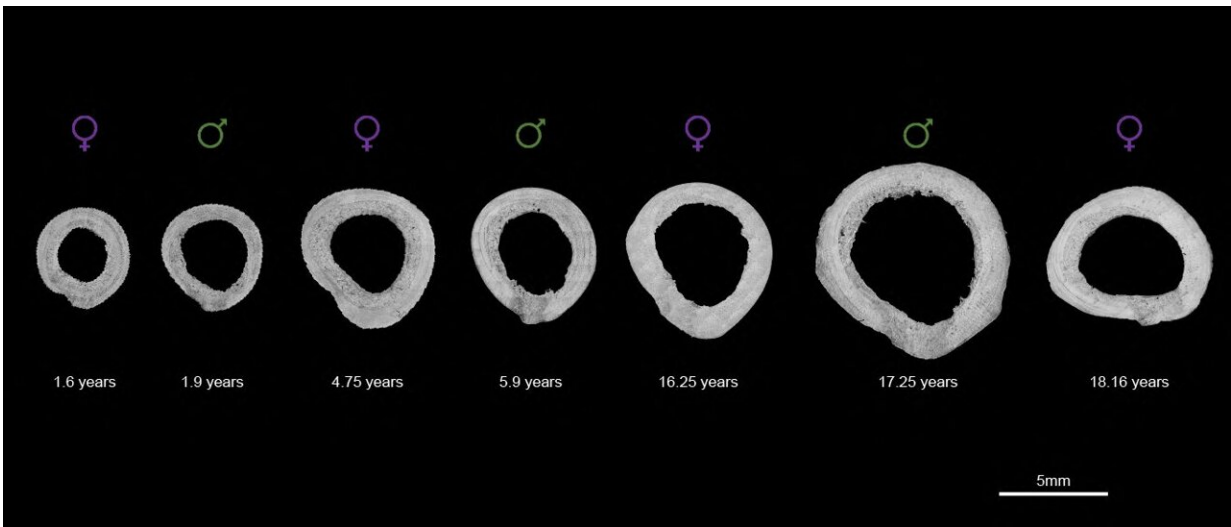


Anthropologists find new ways female bones are permanently altered after giving birth

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Microscope images of the cross section of the seven femora (thigh bones) included in this study, identified by age and sex. Credit: Paola Cerrito and Timothy Bromage.

Reproduction permanently alters females' bones in ways not previously known, a team of anthropologists has found. Its discovery, based on an analysis of primates, sheds new light on how giving birth can permanently change the body.

"Our findings provide additional evidence of the profound impact that reproduction has on the female organism, further demonstrating that the

skeleton is not a static organ, but a dynamic one that changes with [life events](#)," explains Paola Cerrito, who led the research as a doctoral student in NYU's Department of Anthropology and College of Dentistry.

Specifically, the researchers found that calcium, magnesium, and [phosphorus concentrations](#) are lower in females who have experienced reproduction. These changes are linked to giving birth itself and to lactation.

However, they caution that while other [clinical studies](#) show calcium and phosphorus are necessary for optimal bone strength, the new findings do not address overall health implications for either primates or humans. Rather, they say, the work illuminates the dynamic nature of our bones.

"A bone is not a static and dead portion of the skeleton," notes NYU anthropologist Shara Bailey, one of the study's authors. "It continuously adjusts and responds to physiological processes."

The other authors of the study, which appears in the journal *PLOS ONE*, are Timothy Bromage, a professor in NYU College of Dentistry, Bin Hu, an adjunct professor at NYU College of Dentistry, Justin Goldstein, a doctoral candidate at Texas State University, and Rachel Kalisher, a doctoral candidate at Brown University.

It's been long-established that menopause can have an effect on females' bones. Less clear is how preceding life-cycle events, such as reproduction, can influence skeletal composition. To address this, the researchers studied the primary lamellar bone—the main type of bone in a mature skeleton. This aspect of the skeleton is an ideal part of the body to examine because it changes over time and leaves biological markers of these changes, allowing scientists to monitor alterations during the life span.

In the *PLOS ONE* study, the researchers examined the growth rate of lamellar bone in the femora, or thigh bones, of both female and male primates who had lived at the Sabana Seca Field Station in Puerto Rico and died of natural causes. Veterinarians at the field station had monitored and recorded information on these primates' health and reproductive history, allowing the researchers to match bone-composition changes to life events with notable precision.

Cerrito and her colleagues used [electron microscopy](#) and energy-dispersive X-ray analysis—commonly deployed methods to gauge the chemical composition of tissue samples—to calculate changes in concentrations of calcium, phosphorus, oxygen, magnesium, and sodium in the primates' bones.

Their results showed different concentrations of some of these elements in females who gave birth compared males as well as females who did not give birth. Specifically, in females who gave birth, calcium and phosphorus were lower in [bone](#) formed during reproductive events. Moreover, there was a significant decline in magnesium concentration during these primates' breastfeeding of infants.

"Our research shows that even before the cessation of fertility the skeleton responds dynamically to changes in reproductive status," says Cerrito, now a research fellow at ETH Zurich. "Moreover, these findings reaffirm the significant impact giving birth has on a female organism—quite simply, evidence of reproduction is 'written in the bones' for life."

More information: *PLoS ONE* (2022). [DOI: 10.1371/journal.pone.0276866](#)

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